

NASA TECH BRIEF

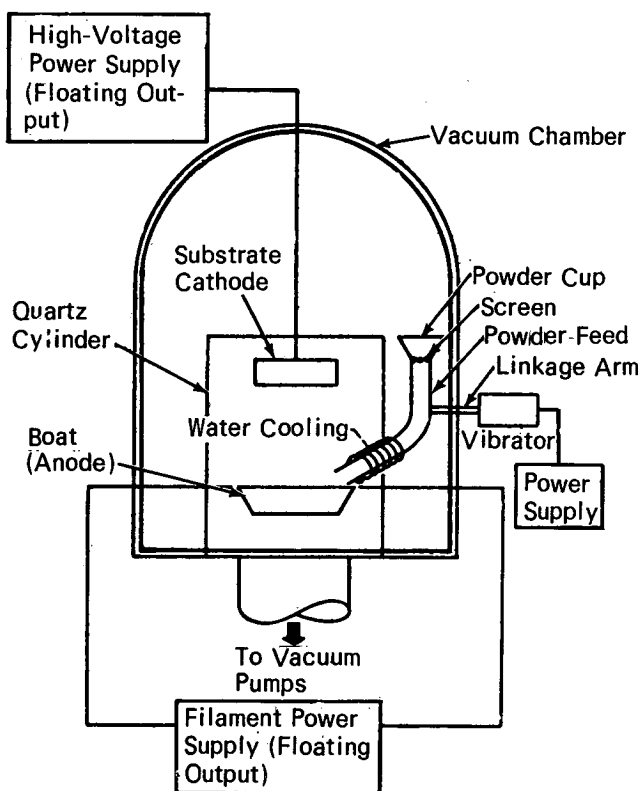
Lewis Research Center



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Alloy Vapor Deposition Using Ion Plating and Flash Evaporation

A new plating method extends the scope of the ion plating technique to include the deposition of alloy films without changing the composition of the



plating alloy. Basically, two independent methods, ion plating and flash evaporation, are combined.

Ion plating permits uniform thin film vapor deposition on complex surfaces, into holes and around corners, in one operation, without rotating or moving the object being plated. Until now, only elemental metals could be deposited by this technique. When

alloys were evaporated by the conventional methods, the composition of the vapor varied continuously, due to the different volatilities of the components, and the resulting deposit was not chemically homogeneous.

With flash evaporation, the alloy to be deposited is continuously fed in powder form into a "boat" which is preheated to the evaporation temperature of the least volatile constituent of the alloy. All of the alloy constituents vaporize instantaneously upon contact with the boat, without fractional decomposition or dissociation. The result is a vapor which deposits on the workpiece to form a film with the same composition as the powdered alloy. The unique characteristics of ion plating are retained. A graded interface is formed due to the penetrating effect of the plating material, and exceptionally strong adherence is obtained between the film and the workpiece surface.

The apparatus combining ion plating with flash evaporation is shown in the figure. This is basically an ion plating unit to which a powdered metal feed system has been added. The vibrator provides for feeding a steady stream of powdered metal into the boat, and controls the rate of feed. In system operation, the vacuum chamber is evacuated, purged, and filled with argon. An electrical potential (3 to 5 kV) is applied across the specimen (cathode) and the boat (anode), and an argon discharge is established. The ionized argon sputter etches the specimen to clean the surfaces for plating. The boat is heated to the preselected temperature and the powdered alloy is fed into it in a steady stream. The alloy evaporates on contact with the boat and the vapor is injected into the glow discharge. A high percentage of the

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evaporated atoms are ionized, and are accelerated toward all exposed surfaces of the specimen.

Three binary alloy systems (with weight percentages as shown) were deposited with this new method: Pb-Sn (50-50), Pb-Sn (35-65), and Cu-Au (85-15). The resulting alloy films were analyzed quantitatively.

It was shown that the original compositions were closely maintained, and that exceptionally strong adherence was obtained between the film and the specimen. Tensile and bending tests showed that the coatings flowed with the specimen material without chipping or peeling.

Ion plating with flash evaporation may be used to plate adherent stoichiometric alloy films on either complex or plane surfaces. The technique is presently the most effective vacuum deposition method for depositing alloys for strong and lasting adherence.

Notes:

1. Ion plating is described in NASA Tech Brief B67-10006.
2. Potential applications include deposition of soft alloy films for lubricating purposes; deposition of alloy films for corrosion or erosion protection; manufacture of alloy film resistors and magnetic alloy films such as those used in the semiconductor field.

3. The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price \$3.00
(or microfiche \$0.95)

Reference:

NASA-TM-X-52823 (N70-32006), Deposition of Alloy Films on Complex Surfaces by Ion Plating with Flash Evaporation.

4. Technical questions may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B71-10199

Patent status:

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